WE CLAIM:

1. A method of measuring methane using a spectrometer in a coal bed methane well with a borehole extending to at least a top surface of at least one coal bed and containing water, comprising:

providing a housing including a radiation source, a detector and a sample interface,

lowering the housing in the well to a depth down the well,

positioning the sample interface to a sample,

irradiating the sample from the radiation source,

detecting a characteristic radiation of the methane from the sample with the detector, and

processing a signal from the detector to calculate a concentration of the methane.

2. A method of measuring according to claim 1, wherein the sample is a face of the coal bed.

3. A method of measuring according to claim 1, wherein the characteristic radiation is emitted, reflected or scattered radiation.

4. A method of measuring according to claim 1, wherein the sample is a volume of water in the well at or near the depth down the well.

5. A method of measuring according to claim 1, wherein the sample is a collected gas from the water which has been depressurized to release the gas.

6. A method of measuring according to claim 1, wherein the sample is chemically treated before the irradiating.

7. A method of measuring according to claim 1, wherein the sample is biologically treated before the irradiating.

8. A method of measuring according to claim 1, wherein the radiation source is selected to minimize fluorescence.

9. A method of measuring according to claim 2, wherein the radiation source is selected to minimize a radiation from the coal.

10. A method of measuring according to claim 2, wherein a wavelength of the radiation source is lower than a wavelength producing maximum fluorescence in the coal.

11. A method of measuring according to claim 1, wherein the sample interface includes at least one lens to focus the radiation from the radiation source, and a focal length of the sample interface is adjusted to mitigate a noise level or to increase the detected characteristic radiation.

12. A method of measuring according to claim 1, wherein the radiation source is a tunable laser located in the housing.

13. A method of measuring according to claim 1, wherein the radiation source is a diode laser with a wavelength between 450 nm and 580 nm.

14. A method of measuring according to claim 1, wherein the detector is an optical fiber transmitting the characteristic radiation to a charge-coupled device.

15. A method of measuring methane in at least one coal bed methane well, comprising:

providing an instrument package in a housing,

lowering the package to a depth down the well,

positioning a radiation source to irradiate a sample and a detector to detect a characteristic radiation from the sample,

irradiating the sample with radiation from the radiation source to produce the characteristic radiation from the sample, and

measuring a concentration of methane in the sample by detecting the characteristic radiation from the sample with the detector, transmitting a signal from the detector to a signal processor and processing the signal to calculate the concentration of the methane in the sample.

16. A method of measuring according to claim 15, wherein the radiation source includes an optical fiber transmitting light waves from a spectrometer near a well head and connected to the housing.

17. A method according to claim 15, further comprising:

lowering the package to at least a second depth down the well, and measuring a concentration of methane at the second depth, in order to obtain concentration of methane versus depth of the well.

18. A method according to claim 15, further comprising:

obtaining concentration of methane versus depth of at least a second well, in order to obtain a potential production of a coal formation.

19. A method according to claim 15, wherein the instrument package is sealed against water and armored to withstand pressure down the well.

20. A method according to claim 15, wherein the package includes a radiation source for supplying a radiation to irradiate the sample.

21. A method according to claim 15, wherein the package includes the detector for detecting the characteristic radiation from the sample and transmitting the signal.

22. A method according to claim 15, wherein the package includes a filter for filtering the radiation from the radiation source.

23. A method according to claim 15, wherein the package includes a filter for filtering the characteristic radiation before the detector.

24. A method according to claim 15, wherein the package includes a filter for filtering the sample from particles in the well.

25. A method according to claim 21, wherein the package includes the signal processor for processing the signal from the detector.

26. A method according to claim 15, wherein the radiation source is a diode laser at a wavelength which minimizes a fluorescence of the coal.

27. A method according to claim 15, wherein the depth is at a top of a water column in the well.

28. A method according to claim 15, wherein the depth is at a top of a first coal bed.

29. A method according to claim 15, wherein the depth is at a top of a second coal bed.

30. A method according to claim 15, wherein the sample is water at or near the depth.

31. A method according to claim 15, wherein the sample is a bacterium or bacterial community.

32. A method according to claim 15, wherein the sample passes through a filter and is brought inside the housing.

33. A method according to claim 15, wherein the housing includes at least one window for transmitting the radiation from the radiation source and the characteristic radiation.

34. A method according to claim 33, wherein the window is positioned next to the sample.

35. A method according to claim 15, wherein the sample is a face of the wellbore.

36. A method according to claim 35, wherein a portion of the housing is pressed into the face of the wellbore.

37. A method according to claim 15, wherein the sample is a face of the coal bed.

38. A method according to claim 35, wherein the face of the wellbore is scraped or prepared to provide a sampling surface.

39. A method according to claim 32, wherein the sample is a gas produced from the water at or near the depth by depressurizing the water inside the housing and collected in a head-space.

40. A method according to claim 15, further comprising selecting a wavelength of the radiation source to mitigate fluorescence.

41. A method according to claim 40, wherein the wavelength is selected to mitigate a radiation from entrained particles in the water.

42. A method according to claim 40, wherein the wavelength is selected to mitigate errors due to length of optical

pathways transmitting the radiation from the radiation source and the characteristic radiation.

43. A measuring system for introduction into a well, comprising:

a housing being traversable up and down the well,

a guide extending down the well from a fixed location and being operatively connected to the housing ,

a spectrometer being located inside the housing and including a radiation source, a sample interface to transmit a radiation from the radiation source to a sample located outside of the housing, and a detector to detect a characteristic radiation emitted, reflected or scattered from the sample and to output a signal, and

a signal processor to process the signal from the detector and calculate a concentration of a substance in the sample.

44. A measuring system for in-situ measurements down a well with a borehole by a spectrometer, comprising:

the spectrometer including a radiation source and a detector,

a probe being optically connected to the spectrometer and including an optical pathway for transmission of a radiation from the radiation source and at least a second optical pathway for transmission of a characteristic radiation from a sample to the detector, and

a positioner to position the probe near a side surface of the borehole and to optically couple the optical pathways to the side surface of the borehole,

wherein the probe is traversable up and down the well by way of a guide operatively connected to the probe and to a fixed location at the wellhead.

45. A measuring system according to claim 44, wherein the sample is methane adsorbed to coal.

46. A measuring system according to claim 44, wherein the optical pathway for transmission of the radiation from the radiation source includes at least one lens for focusing the radiation from the radiation source onto the sample.

47. A measuring system according to claim 44, wherein the positioner includes an adjustable device which extends from the probe and presses a side of the wellbore.

48. A measuring system according to claim 44, wherein the radiation source is a diode laser at a wavelength of 450 nm to 580 nm.

49. A measuring system according to claim 44, wherein a filter is located between the radiation source and the sample to filter the radiation from the radiation source.

50. A measuring system according to claim 44, wherein at least one filter is located between the sample and the detector to filter the characteristic radiation.

51. A measuring system according to claim 43, wherein the probe has no moving parts.

52. A measuring system according to claim 44, wherein the probe includes the spectrometer.

53. A measuring system according to claim 52, wherein the probe is armored against pressure and sealed against liquids.

54. A measuring system according to claim 44, wherein an error corrector is provided to correct for inherent system noise and errors.

55. A measuring system according to claim 44, wherein the probe is optically connected to the radiation source via at least one optical fiber.

56. A measuring system according to claim 44, wherein the probe is optically connected to the detector via at least one optical fiber.

57. A measuring system according to claim 52, wherein the probe includes a high-pressure feed-through jacket for an optical fiber which interfaces between the enclosed spectrometer and the wellbore.

58. A measuring system according to claim 44, wherein the probe is streamlined so as not to substantially disturb the water in the well.

59. A measuring system according to claim 44, wherein the radiation source is a UV/Vis spectrometer.

60. A measuring system according to claim 44, wherein the radiation source is a near IR spectrometer.

61. A measuring system according to claim 44, wherein the radiation source is a Raman spectrometer.

62. A measuring system according to claim 44, wherein the radiation source is an infrared spectrometer.

63. A measuring system according to claim 44, wherein the radiation source is a fluorimeter.

64. A measuring system according to claim 44, wherein the detector is a charge-coupled device.

65. A measuring system according to claim 44, wherein the detector includes at least one of a photomultiplier tube, a photo-diode array, an avalanche photo-diode, a charge injection device and a complimentary metal-oxide semiconductor image sensor.

66. A measuring system according to claim 52, wherein the probe includes a reflector to direct the radiation from the radiation source to the sample and a second reflector to direct the characteristic radiation from the sample to the detector.

67. A method of measuring a side surface of a borehole using optical spectrometers, comprising:

providing the optical spectrometer including a radiation source and a detector,

optically connecting the side surface of the borehole to the radiation source and the detector,

irradiating the side surface of the borehole with radiation from the radiation source,

collecting a characteristic radiation emitted, reflected or scattered from an interaction between the side surface of the borehole and the radiation from the radiation source,

transmitting the characteristic radiation to the detector to thereby produce a signal,

transmitting the signal to a signal processor, and

calculating a concentration of a substance on the side surface of the borehole.

68. A method according to claim 67, wherein the side surface of the borehole is a face of a coal seam.

69. A method according to claim 67, wherein the side surface is optically connected by at least one lens which focuses the radiation from the radiation source onto the side surface.

70. A method according to claim 67, wherein the side surface is optically connected to the radiation from the radiation source by at least one fiber optic which is positioned near the side surface.

71. A method according to claim 70, wherein the fiber optic is pressed into the side surface.

72. A method according to claim 67, wherein the side surface is optically connected to the radiation from the radiation source via a window or lens in a housing.

73. A method according to claim 72, wherein the housing is pressed into the side surface.

74. A method according to claim 72, wherein the housing is lowered down the wellbore and is positioned near the side surface by an adjustable device extending from the housing.

75. A method according to claim 72, wherein the spectrometer is located in the housing.

76. A method according to claim 67, wherein the radiation source is a diode laser with a wavelength between 450 nm and 580 nm.